Adding timing to the LHCb VELO

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The LHCb experiment is designed to perform high precision measurements of matter-antimatter asymmetries and searches for rare and forbidden decays, with the aim of discovering new and unexpected particles and forces. In 2030 the LHC beam intensity will increase by a factor of 50 compared to current operations. This means increased samples of the particles we need to study, but it also presents experimental challenges. In particular, with current technology it becomes impossible to differentiate the many (>50) separate proton-proton collisions which occur for each bunch crossing. A Monte Carlo simulation was developed to model the operation of a silicon pixel vertex detector surrounding the collision region at LHCb, under the conditions expected after 2030, after the second upgrade of the Vertex Locator(VELO).The main goal was studying the effect of adding '4D' detectors which save high-precision timing information, in addition to the usual three spatial coordinates, as charged particles pass through them. With the additional information on the particle timing, it is possible to separately reconstruct the individual 50+ collisions, allowing the next generation of high-precision measurements to be made at the LHCb.

Presenters: MITRESKA, Biljana (CERN);   WILLIAMS, Mark Richard James (University of Manchester (GB))

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